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IS 6529 (1996): Stainless steel blooms, billets and slabs for forging [MTD 16: Alloy Steels and Forgings]

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(पहला पुनरीक्षण)

Indian Standard

STAINLESS STEEL BLOOMS, BILLETS AND SLABS FOR FORGINGS — SPECIFICATION

(First Revision)

(Incorporating Amendment No. 1)

ICS 77.140.60;77 140.80

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Price Group 2

Alloy Steels and Special Steels Sectional Committee, MTD 16

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Alloy Steels and Special Steels Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1972. While reviewing the standard in the light of experience gained, the committee felt that it should be revised to bring it in line with the present practices being followed in the country in this field.

An informative Annex A has been included for the benefit of the purchaser giving particulars to be specified by the purchaser while placing order for the steels covered in this standard

While preparing this standard, assistance has been derived from the following standards:

ISO/DIS 683/XIII Heat-treated steels, alloy steels and free-cutting steels. Part 13 Wrought stainless steels. International Organisation for Standardization.

BS 970 · Part 4 : 1970 Stainless, Heat Resisting and Valve Steels. British Standards Institution, BSI.

AISI Steel Products Manual Stainless and Heat Resisting Steels. American Iron and Steel Institute, USA

ASTM A 314.87 Stainless and Heat Resisting Steel and Bars for Forgings. American Society for Testing and Materials.

This edition 2.1 incorporates Amendment No. 1 (June 1999) Side bar indicates modification of the text as the result of incorporation of the amendment.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

STAINLESS STEEL BLOOMS, BILLETS AND SLABS FOR FORGINGS — SPECIFICATION

(First Revision)

1 SCOPE

This standard covers the requirements for stainless steel blooms, billets and slabs for forgings.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard

IS No.	*Title*
228 (issued in parts)	Methods for chemical analysis of steels
1500 : 1983	Method for Brinell hardness test for metallic materials (*second revision*)
1762 (Part 1) : 1974	Code for designation of steels . Part 1 Based on letter symbols
1956 (Part 3) : 1975	Glossary of terms relating to iron, and steel · Part 3 Hot rolled steel products (excluding sheet and strip) (*first revision*)
2049 1978	Colour code for the identification of wrought steels for general engineering purpose (*first revision*)
3739 : 1987	Dimensional tolerances for carbon and alloy constructional steel products (*first revision*)
8910 : 1978	General technical delivery requirements for steel and steel products
10461 (Part 1) : 1994	Method for determination of resistance to intergranular corrosion of austenitic stainless steel Part 1 Corrosion tests in nitric acid by measurement of loss in mass (Huoy test)
10461 (Part 2) : 1994	Method for determination of resistance to intergranular corrosion of austenitic stainless steel : Part 2 Copper sulphate/sulphuric acid test (Monypenny Straus test) (*first revision*)

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 1956 (Part 3) : 1975 shall apply.

4 SUPPLY OF MATERIAL

4.1 General requirements for the supply of material shall be in accordance with IS 8910 · 1978.

4.2 Steels covered by this standard shall be ordered and delivered on the basis of:

a) Chemical composition, or

b) Chemical composition and hardness in the annealed condition.

5 MANUFACTURE

5.1 Unless agreed otherwise in order, the process used in making the steel and the products are left to the discretion of the manufacturer When so desired, the purchaser shall be informed on the steel making process.

5.2 Blooms, billets and slabs may be processed from ingots or continuously cast slabs, blooms or billets, by rolling, extrusion, hammering or pressing Reduction ratio may be agreed to between manufacturer and purchaser

5.3 Sufficient discard shall be made after processing ingots or continuously cast product to ensure freedom from pipe, harmful segregation and other harmful defects.

5.4 Conditioning of harmful surface defects by grinding shall be permitted provided that the finish dimension is not less than that specified and that the operation is not likely to affect the end-use of the product

6 FREEDOM FROM DEFECTS

Blooms, billets and slabs shall be free from cracks, surface flaws, laps, rough, jagged and imperfect edges and all other defects which may result in defects in the end product

7 CHEMICAL COMPOSITION

7.1 The ladle analysis of steel shall be as given in Table 1. The analysis of steel be carried out either by the method specified in IS 228 and its relevant parts or any other established instrumental/chemical method. In case of dispute the procedure given in IS 228 and its relevant parts shall be referee method. However, where the method is not given in IS 228 and its relevant parts, the referee method shall be agreed to between the purchaser and the manufacturer.

Table 1 Chemical Composition

(*Clauses* 7.1, 7.2, 7.3 *and* 12.1)

Steel Designation IS 1762 (Part 1) 1974	Constituent, Percent										
	C	Si	Mn	Ni	Cr	Mo	Ti	Nb	S Percent *Max*	P Percent *Max*	Others
(1)	(3)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Austenitic Steels											
X02Cr19Ni10	0.030 *Max*	1.0 *Max*	2.0 *Max*	8.0-12.0	17.0-20.0	—	—	—	0.030	0.045	—
X04Cr19Ni9	0.08 *Max*	1.0 *Max*	2.0 *Max*	8.0-10.0	17.0-20.0	—	—	—	0.030	0.045	—
X07Cr18Ni9	0.15 *Max*	1.0 *Max*	2.0 *Max*	8.0-10.0	17.0-19.0	—	—	—	0.030	0.045	—
X04Cr18Ni10Ti	0.08 *Max*	1.0 *Max*	2.0 *Max*	9.0-12.0	17.0-19.0	—	5C to 0.80	—	0.030	0.045	—
X04Cr18Ni10Nb	0.09 *Max*	1.0 *Max*	2.0 *Max*	9.0-12.0	17.0-19.0	—	—	10C to 1.0	0.030	0.045	—
X04Cr17Ni12Mo2	0.08 *Max*	1.0 *Max*	2.0 *Max*	10.0-14.0	16.0-18.0	2.0-3.0	—	—	0.030	0.045	—
X02Cr17Ni12Mo2	0.030 *Max*	1.0 *Max*	2.0 *Max*	10.5-14.0	16.0-18.5	2.0-3.0	—	—	0.030	0.045	—
X04Cr17Ni12Mo2Ti	0.080 *Max*	1.0 *Max*	2.0 *Max*	10.5-14.0	16.0-18.5	2.0-3.0	5C to 0.8	—	0.030	0.045	—
X10Cr17Mn6Ni4N	0.20 *Max*	1.0 *Max*	4.0-8.0	3.5-5.5	16.0-18.0	—	—	—	0.030	0.060	(N 0.05-0.25)
Ferritic Steels											
X04Cr12	0.08 *Max*	1.0 *Max*	1.0 *Max*	—	11.5-13.5	—	—	—	0.030	0.040	—
X07Cr17	0.12 *Max*	1.0 *Max*	1.0 *Max*	0.50 *Max*	16.0-18.0	—	—	—	0.030	0.040	—
Martensitic Steels											
X12Cr12	0.08-0.15	1.0 *Max*	1.0 *Max*	1.0 *Max*	11.5-13.5	—	—	—	0.030	0.040	—
X20Cr13	0.16-0.25	1.0 *Max*	1.0 *Max*	1.0 *Max*	12.0-14.0	—	—	—	0.030	0.040	—
X30Cr13	0.26-0.35	1.0 *Max*	1.0 *Max*	1.0 *Max*	12.0-14.0	—	—	—	0.030	0.040	—
X40Cr13	0.36-0.45	1.0 *Max*	1.0 *Max*	1.0 *Max*	12.5-14.5	—	—	—	0.030	0.040	—
X15Cr16Ni2	0.10-0.20	1.0 *Max*	1.0 *Max*	1.5-3.0	15.0-18.0	—	—	—	0.030	0.040	—
X108Cr17Mo	0.95-1.20	1.0 *Max*	1.0 *Max*	0.50 *Max*	16.0-18.0	0.75 *Max*	—	—	0.030	0.045	—

NOTES

1 For free cutting varieties in the first four grades in Martensitic steels and first grade in Ferritic steels, Sulphur and Selenium content shall be as agreed between the purchaser and the manufacturer

2 Tantalum if analysed, is determined along with Nb and expressed in the form of Nb content

7.2 Product Analysis

The permissible variation in case of product analysis for limits specified in Table 1 shall be as given in Table 2.

Table 2 Permissible Variation Between Specified Analysis and Product Analysis

(*Clauses* 7.2 *and* 12.1)

Element	Limit Shown in Table 1 for Content in the Cast Analysis, Percent		Permissible Deviation, Percent
	Over	Up to and Including	
C	—	0.030	+ 0.005
	0.030	0.20	± 0.01
	0.20	0.60	± 0.02
	0.60	1.20	± 0.03
Si	—	1.0	+ 0.05
Mn	—	1.0	+ 0.03
	1.0	3.0	± 0.04
	3.0	6.0	± 0.05
	6.0	7.5	± 0.06
Cr	10.0	15.0	± 0.15
	15.0	20.0	± 0.20
Mo	—	0.60	+ 0.03
	0.60	1.75	± 0.05
	1.75	3.0	± 0.10
Ni	—	1.0	+ 0.03
	1.0	5.0	± 0.07
	5.0	10.0	± 0.10
	10.0	14.0	± 0.15
N	0.05	0.25	+ 0.02 − 0.01
Ti	—	0.8	± 0.05
Nb	—	1.0	± 0.05
S	—	0.030	+ 0.005
P	—	0.040	+ 0.005
	0.040	0.060	± 0.010

NOTE — ± means that in one cast the deviation may occur over the upper value or under the lower value of the specified range in Table 1, but not both at the same time

7.3 Elements not specified in Table 1 shall not be added to the steel except where agreed to, other than for the purpose of finishing the heat and shall not exceed the following limits:

Constituent	*Percent, Max*	
	Ferritic and Martensitic Steels	Austenitic Steels
Titanium	—	0.10
Niobium	—	*0.20*
Molybdenum	0.30	0.70
Copper	0.30	0.50

8 HEAT TREATMENT

8.1 The blooms, billets and slabs for forging may be supplied in annealed condition in case of ferritic and martensitic types and in as rolled/as forged condition in case of austenitic type.

8.2 Recommended heat treatment for the steels covered in this standard is given in Annex B.

9 HARDNESS

9.1 If the steels are supplied in the annealed or softened condition, the maximum acceptable hardness shall be as laid down in Tables 3 and 4.

Table 3 Brinell Hardness After Annealing
(*Clauses* 9.1 *and* 12.2)

Steel Designation	*HB, Max*
X04Cr12	197
X12Cr12	200
X20Cr13	220
X30Cr13	235
X40Cr13	255
X07Cr17	192
X15Cr16Ni2	262
X108Cr17Mo	285

NOTE — For small sections the HRB or HV hardness test may be used by agreement between the manufacturer and the purchaser

Table 4 Brinell Hardness After Softening Treatment
(*Clauses* 9.1 *and* 12.2)

Steel Designation	*HB, Max*
X02Cr19Ni10	192
X04Cr19Ni9	192
X07Cr18Ni9	192
X04Cr18Ni10Ti	192
X04Cr18Ni10Nb	192
X04Cr17Ni12Mo2	192
X02Cr17Ni12Mo2	192
X04Cr17Ni12Mo2Ti	192
X10Cr17Mn6Ni4N	217

9.2 The hardness test shall be carried out in accordance with IS 1500 : 1983.

10 DIMENSIONAL TOLERANCES

10.1 Tolerances for stainless steel billets shall be as given in IS 3739 : 1987.

10.2 In case of blooms and slabs, tolerances shall be within ±5 percent of the specified dimension.

11 SAMPLING

11.1 Sampling for Chemical Analysis

The ladle analysis shall be supplied by the manufacturer. If the product analysis is required by the purchaser, at least one sample product shall be taken from each cast.

11.2 Sampling for Hardness Test

If the material is supplied in the heat-treated condition, one sample product shall be taken from each heat-treatment batch for testing. If the product is continuously heat-treated, one sample product for each 15 tonnes or part thereof, subject to the minimum of one sample product for each cast shall be taken.

12 RETEST

12.1 Retest for Product Analysis

If the results of the product analysis do not conform to the requirements given in Tables 1 and 2, unless otherwise agreed to between the purchaser and the manufacturer, two new samples shall be taken on different pieces from the same cast. Should the two analysis satisfy the requirements, the lot represented shall be accepted. Should either of the samples fail, the material shall be taken as not complying with this standard.

12.2 Retest for Hardness Determination

If the samples selected under **11.2** fail to meet the requirements of Tables 3 and 4, two further samples be selected from the same heat-treatment batch. The consignment shall be considered to conform to the requirements if both the additional tests are satisfactory. Should either of the samples fail, the manufacturer shall have the right, if he so desires, to re-heat-treat the product (not more than twice) in any suitable manner before two fresh samples are taken for testing. Should the tests satisfy the requirements of this standard, the lot represented shall be accepted. Should either of the samples fail, the material shall be taken as not complying with this standard.

13 CORROSION RESISTANCE

13.1 If required by the purchaser, austenitic stainless steel shall be tested for corrosion resistance as per IS 10461 (Part 1) : 1994 and IS 10461 (Part 2) : 1994.

14 MARKING

14.1 Each bloom, billet and slab shall be legibly stamped with the cast number and designation of steel.

14.2 The material may also be suitably colour coded in accordance with IS 2049 1978.

14.3 Standard Marking

The material may also be marked with the Standard Mark.

14.3.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(*Foreword*)

INFORMATION TO BE GIVEN BY THE PURCHASER

A-1 BASIS FOR ORDER

A-1.1 While placing order for stainless steel blooms, billets and slabs for forgings, covered by the standard, the purchaser should specify the following:

a) Designation of steel;

b) Description regarding size, length, etc,

c) Condition of delivery;

d) Tests required,

e) Methods of manufacture;

f) Any special requirements; and

g) Test report, if required

ANNEX B

(*Clause* 8.2)

RECOMMENDED HEAT TREATMENT FOR STAINLESS STEELS

Steel Designation	*Symbol*[1] *Temperature* (°C)	*Annealing/Softening Media*[2]	*Cooling*
(1)	(2)	(3)	(4)
Austenitic Steels			
X02Cr19Ni10	S	1 000 to 1 120	w, a
X04Cr19Ni9	S	1 000 to 1 120	,,
X07Cr18Ni9	S	1 000 to 1 120	,,
X04Cr18Ni10Ti	S	1 000 to 1 120	,,
X04Cr18Ni10Nb	S	1 000 to 1 120	,,
X04Cr17Ni12Mo2	S	1 000 to 1 120	,,
X02Cr17Ni12Mo2	S	1 000 to 1 120	,,
X04Cr17Ni12Mo2Ti	S	1 000 to 1 120	,,
X10Cr17Mn6Ni4N	S	1 000 to 1 120	,,
Ferritic Steels			
X04Cr12	A	700 to 800	f, a
X07Cr17	A	750 to 850	a, w
Martensitic Steels			
X12Cr12	A	700 to 780	a
	A	770 to 870	f
X20Cr13	A	770 to 870	f
X30Cr13	A	770 to 870	f
X40Cr13	A	770 to 870	f
		750 to 800	a
X15Cr16Ni2	A	620 to 670	a
X108Cr17Mo		780 to 880	f

[1] A = Annealing, S = Softening

[2] f = Furnace, a = Air, and w = Water.

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